PCoP Conference 2008

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Eustatic Sea Level Rise

Dennis Mekkers, PE
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CESAM-EN-HH

Sea Level Rise

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Historic Magnitude

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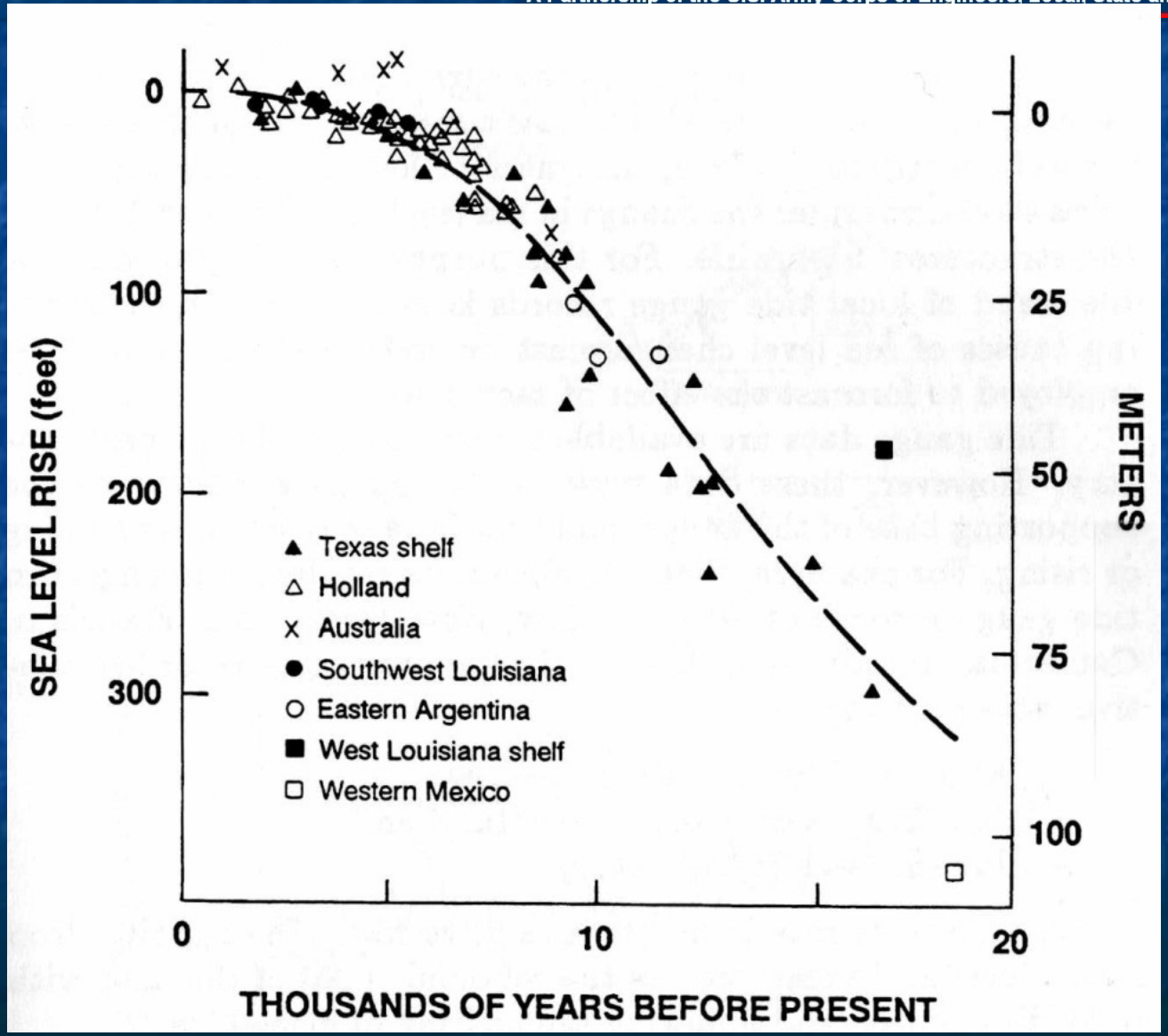

Sea Level Rise Rates 1940-1980 Period

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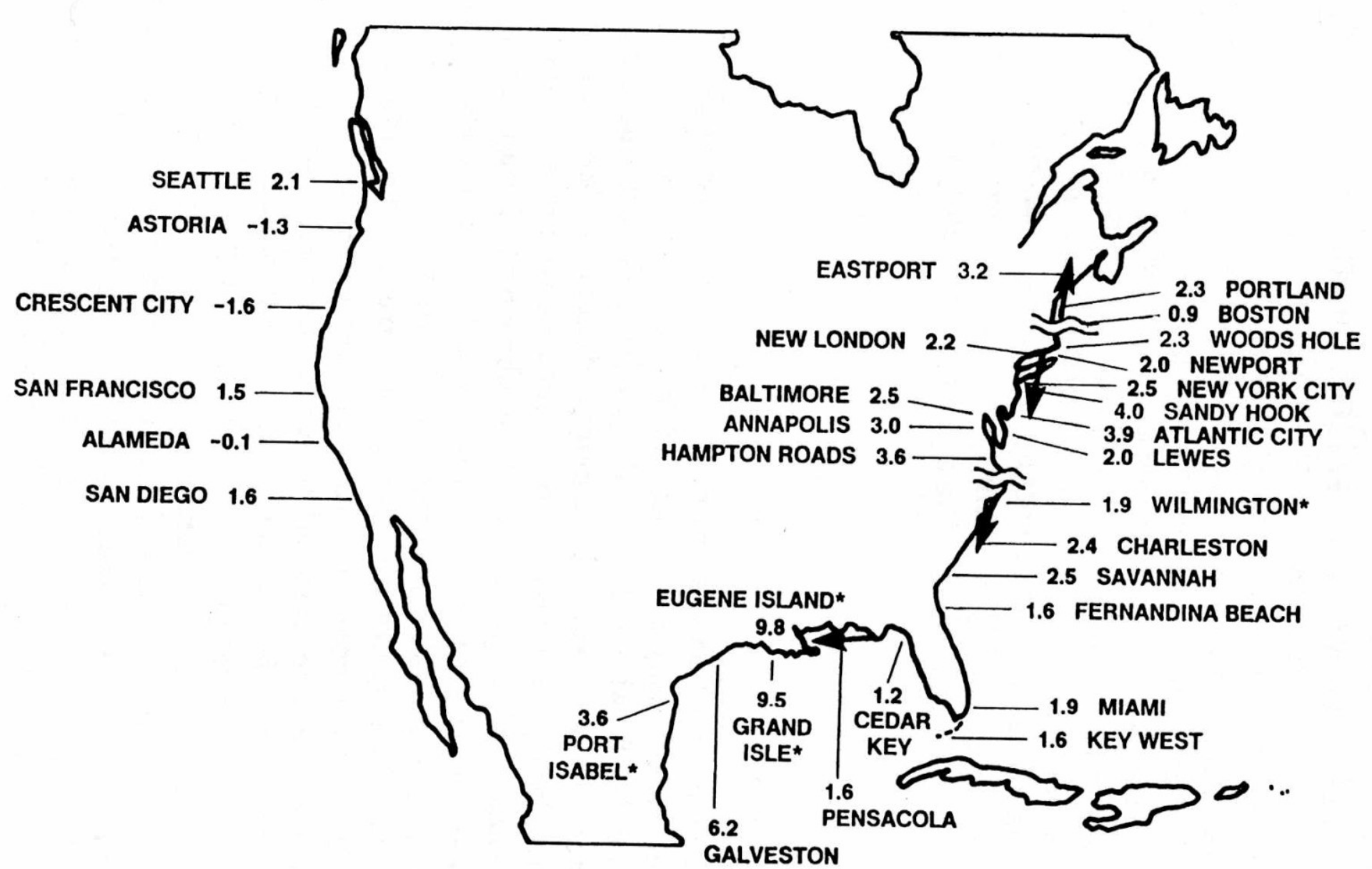

USACE Guidance

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funded or authorized by the Federal Government. The MOA and lease must be executed prior to PCA approval and execution. This is addressed in more detail in ER 1165-2-131.

k. Sea Level Rise. The National Research Council (NRC) study on sea level change (Responding to Changes in Sea Level: Engineering Implications, 1987) is a practical and rational review of data on relative sea level changes and the resulting impact on engineering structures. The study should be used by the Corps for technical guidance until more definitive data are available. The NRC study recommended that feasibility studies for coastal projects should consider the high probability of accelerated sea level rise. Since precise estimates of future sea level rise are unknown, the risks associated with a substantial rise should be addressed. Feasibility studies should consider which designs are most appropriate for a range of possible future rates of rise. Strategies that would be appropriate for the entire range of uncertainty should receive preference over those that would be optimal for a particular rate of rise but unsuccessful for other possible outcomes.

(1) Potential relative sea level change should be considered in every coastal and estuarine (as far inland as the new head of tide) feasibility study that the Corps undertakes. The degree of consideration that the possible change receives will depend upon the historical record for the study site. Areas which are already experiencing relative sea level rise or where increases are predicted should undertake an analysis as part of the study. Plans should be formulated using currently accepted design criteria.

(2) For now, planning should consider what impact a higher relative sea level rises rate would have on the design based on the historical rate. A sensitivity analysis should be conducted to determine what effect (if any) changes in sea level would have on plan evaluation and selection. This analysis should be based, as a minimum, on the extrapolation of the local, historical record of relative sea level rise as the low level and Curve III from the NRC report as the high level.

(3) If the plan selection is sensitive to sea level rise, then design considerations could allow for future modification when the impacts of future sea level rise can be confirmed. It may be appropriate to consider plans that are designed for today's conditions but that incorporate features to facilitate future changes, or plans designed for future conditions. In these cases, an evaluation of the timing and the cost of potential changes should be conducted during the plan selection process.

E-25. Federal and Non-Federal Participation

a. General Requirements.

(1) The Federal approach to participation in shore protection is similar to that for participation in riverine flood damage reduction. Highest priority is for reducing damages to existing development. Reducing flooding on or erosion to undeveloped lands is not high priority. Federal participation in the protection of private undeveloped shores is prohibited by law.

- Consider sea level rise for feasibility studies
- Conduct sensitivity analysis
- Strive to identify robust and/or adaptable solutions

Relative Sea Level Rise

Frame of Reference: observer standing on the shoreline

Components: Eustatic (water) and Terrestrial (Subsidence/Uplift)

Sea Level Rise

Eustatic = eu , static

=> good , stationary

????

MSCIP

Determine

Mississippi Coast Relative Sea Level Rise Rates

Predict possible future rise

Combine observed rates with eustatic rise predictions

Conduct Flood Damage Analysis on

Present Sea Level

‘Expected’ Sea Level Rise

‘High’ Level Rise

MS Historic Rates

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Location	Rise in mm/yr	Std. Error of Rise
Gulfport, MS	1.70	0.52
Record	1964-1999	
Biloxi, MS	2.26	0.26
Record	1928-'76, '79-98	
Pascagoula, MS	3.72	0.30
Record	1940-'97	

MS Rise Predictions

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Comparison of Computed Relative Sea Level Rise Estimates, 2005-2100

	Gulfport		Pascagoula		Biloxi	
Basis	**High[1] m. (ft)**	**Expected[2] m. (ft.)**	**High[1] m. (ft)**	**Expected[2] m. (ft.)**	**High[1] m. (ft)**	**Expected[2] m. (ft.)**
Extrapolated	-	0.16 (0.5)	-	0.35 (1.2)	-	0.21 (0.7)
NRC (1987)	1.49 (4.9)	1.00 (3.3)	1.68 (5.51)	1.19 (3.9)	1.51 (5.0)	1.05 (3.5)
EPA (1995)	0.99 (3.2)	0.39 (1.3)	1.18 (3.9)	0.60 (2.0)	0.98 (3.2)	0.44 (1.4)
IPCC (2001)	**0.96 (3.2)**	**0.54 (1.8)**	**1.16 (3.8)**	**0.74 (2.4)**	**1.02 (3.3)**	**0.60 (2.0)**
	Values in **bold** are adopted.					

Notes: 1. NRC Curve 3; EPA 99% non-exceedence; IPCC upper-bound. 2. NRC Curve 2; EPA 50% non-exceedeence; IPCC 'central value'.

Eustatic Rise Predictions ~1990 - 2100

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	High (m)	Middling (m)	Low (m)
NRC '87	1.5	1.0	0.5
EPA '95	0.77	0.25	0.05
IPCC '01	0.88	0.48	0.1
IPCC '07	0.59	0.34	0.18

Eustatic Contribution

Average 100 yr. Eustatic Rate/Observed Rate

Biloxi, MS

	High (m)	Middling (m)	Low (m)
NRC '87	6	4	2
EPA '95	3.1	1	0.2
IPCC '01	3.5	1.9	0.4
IPCC '07	2.4	1.3	0.7

Eustatic Predictions

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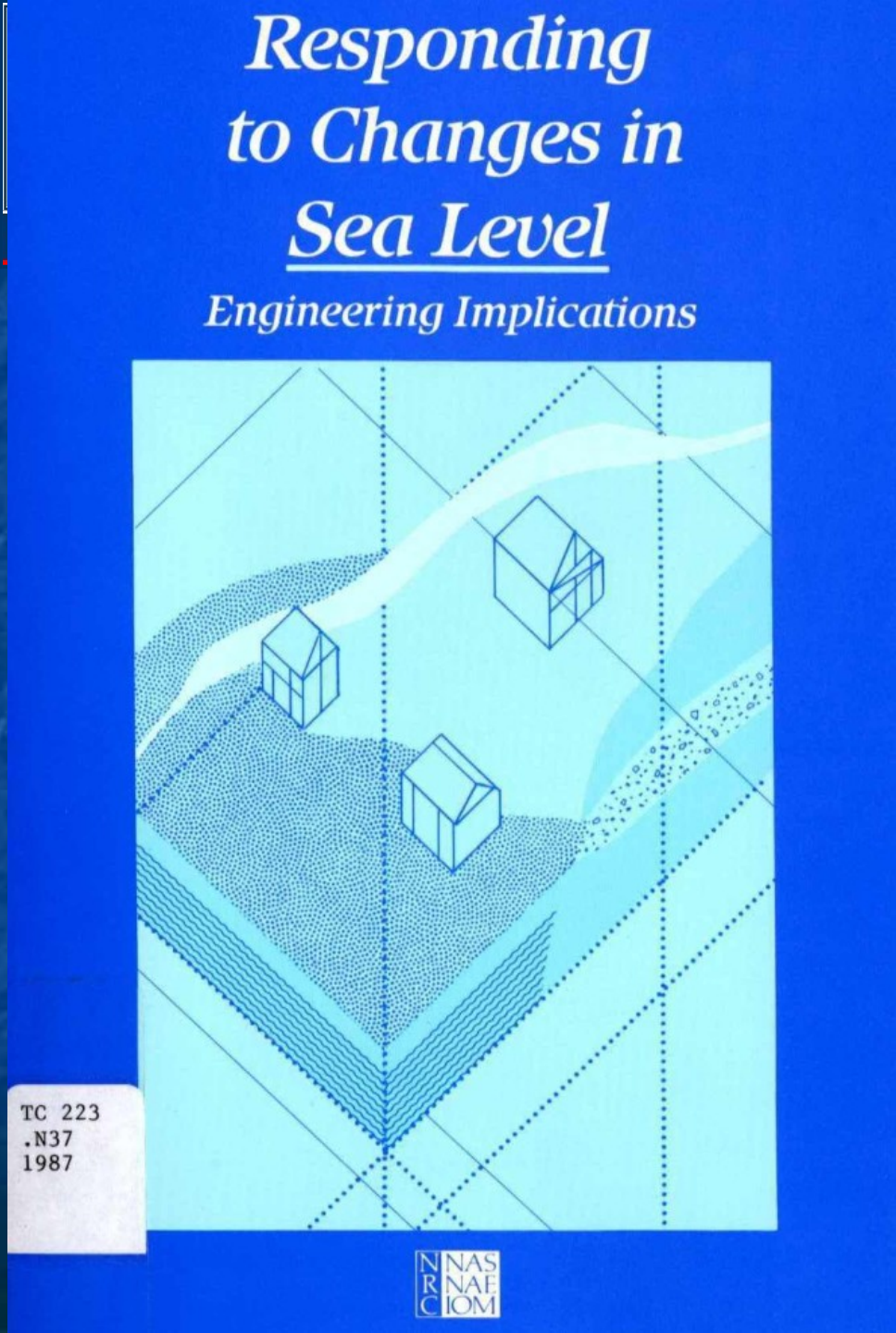
	Continuous?	Uncertainty ?	Reliable ?
NRC ‘87	√	-	?
EPA ‘95	-	√	?
IPCC ‘01	√	-	?
IPCC ‘07	-	-	?

Eustatic Estimates

NRC
1987



Key Takeaway Points

Eustatic rise predictions are problematic but accessible

Eustatic rise predictions are increasingly large over time with respect to historically observed rates

Regionally specific, continuous function/graphic rise predictions with uncertainty are desired

Rise acceleration (and deceleration) can only be verified as ‘truth’ (persistent) many years after the fact, and only for the past

Plans can be sensitive to the chosen prediction

Guidance and tools need to be mutually advanced

Last Key Point

Much of what USACE has done and will ever do is based largely on prediction.

QUESTIONS???

Sea Level Rise Resources

ftp://ftp.sam.usace.army.mil/outgoing/Mekkers/Sea%20Level/

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